How do changes in Forest Carbon Stocks correlates with Surface Temperature Changes

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1 Introduction

In this project we are going to explore how changes in the forest carbon stock correlates with the surface temperature, do we even have a correlation in both or not.

2 Data Sources

2.1 Forest and Carbon Dataset

- **Metadata URL:** IMF Forest Data This dataset provide forest areas and carbon stock in forest and land area from 1992 to 2020, this is open source data from International Monetary Fund (IMF)

2.2 Annual Surface Temperature Change Dataset

- **Metadata URL:** IMF Surface Temperature Data This data Provides Mean surface temperature change from 1961-2021 for different countries, data is open source provided by International Monetary Fund (IMF).

2.3 Data Structure and Quality

- Both Datasets are in CSV format and after transformation stored in a SQLite Database, the dataset is also majorly complete and consistent and accurate.
- **Tables:**
  - *Annual_Surface_Temperature_Change:* Columns for *Country*, *Indicator*, and annual data from 1961 to 2022.
  - *Forest_and_Carbon:* Columns for *Country*, *Indicator*, and annual data from 1992 to 2020.
  - *Temp_Change_Diff:* Annual differences in temperature change for each country.
  - *Carbon_Stocks_Diff:* Annual differences in carbon stocks for each country.

2.4 Licenses

datasets can be used and distributed with proper citation. IMF Data Terms of Use. This open data policy facilitates academic and public research.

3 Data Pipeline

3.1 Description

The pipeline fetches the data from the URLs first, then it cleans the data by removing those that that contains missing values and convert the required column to numeric format,then it transforms the data for analysis by calculating the annual differences in temperature and carbon stocks and finally in last stores the data in a SQLite database using Python, pandas, and SQLite. it basically follow ETL(Extract, Transform, Load) Pipeline standard.

3.2 Transformation and Cleaning Steps

we first downloaded the data and loaded it into the Pandas dataframe then we removed the columns that are not so important for data simplification and then we removed the records that had some missing values, converted the required column types to numeric for a better analysis result, made the country colum an index and finally Computed Yearly changes to find out the trends over time.

4 Analysis

In this Analysis we are going to explore the correlation b/w changes in forest carbon stock and surface temperature change.

4.1 Data Loading and Merging

- The data we processed was loaded from SQLite database.
- i merged both temperature and carbon stock datasets based on country column.
- then i calculated the differences to plot the result in the graph.

4.2 Correlation Calculation

- global changes in carbon stocks and temperature were calculated.
- also we calculated correlation coefficients in b/w carbon stocks and surface temperature for each year

4.3 Visualization

- **Time Series Plot**: We produce the time series plot of temperature and carbon stock globally
- **Correlation Over the Years**: We have utilized graphs to show the correlation coefficients between carbon stock and surface temperature change in each year.

4.4 Results

What we found out by doing the Analysis is that:

- **Time Series Plot**: Time Series Graph of Global Yearly Surface Temperature Anomaly vs. Carbon Stocks showed patterns, temperature changes fluctuate approaching zero, which means that annual changes are minimal. on the other hand, carbon Changes in stock, particularly after 2010 are more unstable.

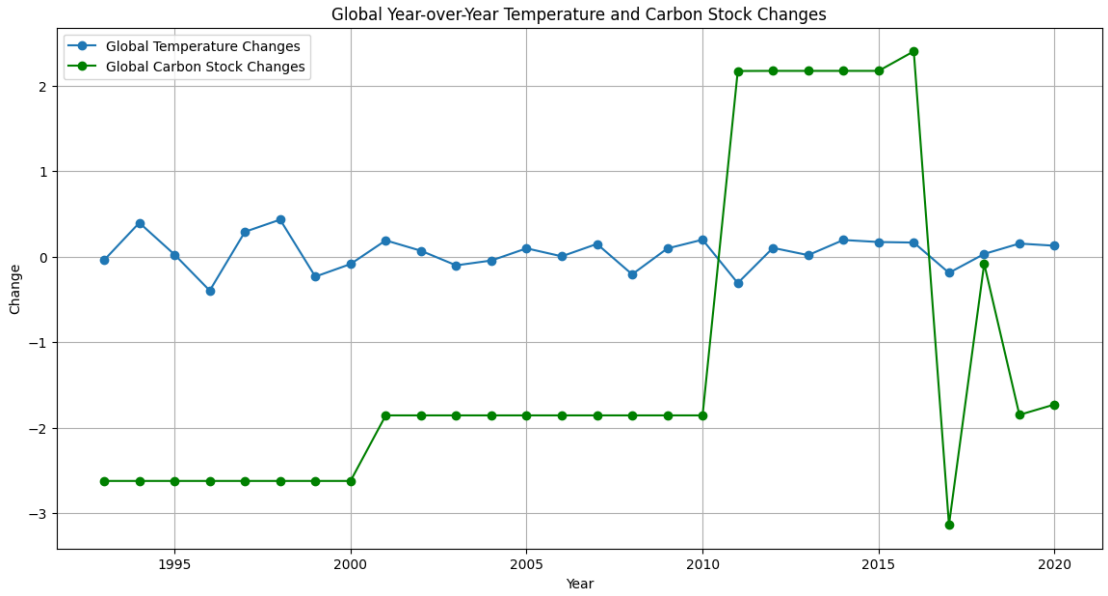

Figure 1: Global Year-over-Year Temperature and Carbon Stock Changes

- **Correlation Over Years**: Years Elapsed Since Both: Correlation coefficients for-for temperature and yearly changes in carbon stock highly differ, 0.20 to -0.15 This also tells you that the relationship between these variables is not constant and which variability in them indicates non constancy.

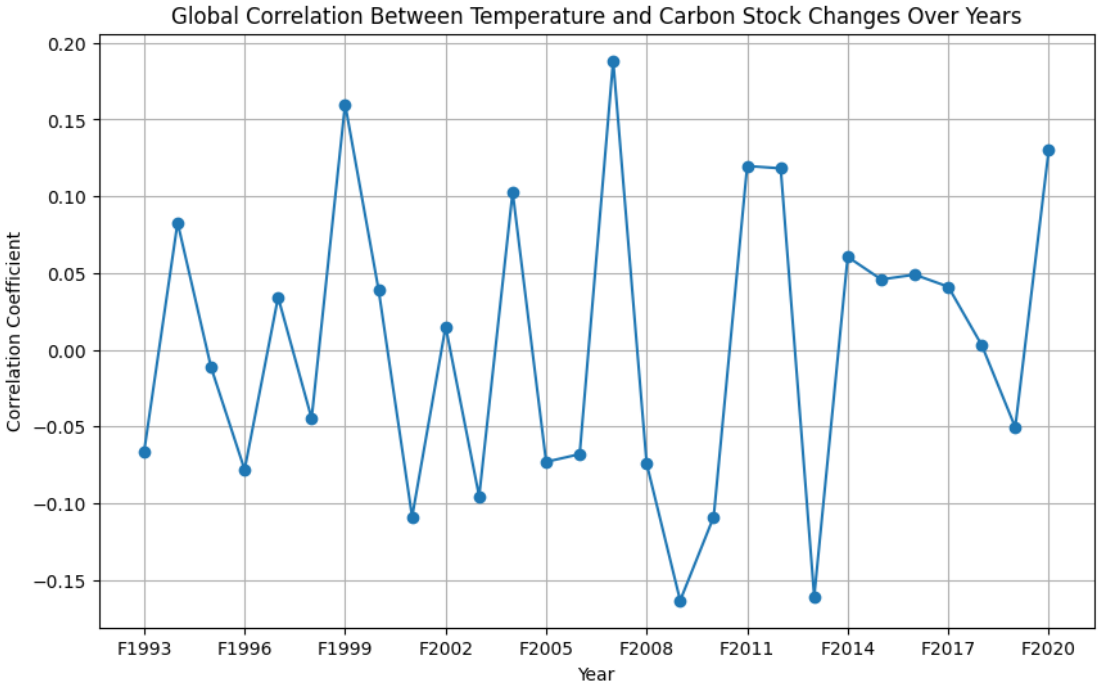

Figure 2: Global Correlation Between Temperature and Carbon Stock Changes Over Years

5 Conclusions

After analysis we found out that there is no consistent, strong correlation between changes in forest carbon stocks and surface temperature changes globally, The correlation coefficients vary significantly across different years, which suggests that other factors may influence these variables.

Key Findings:

- There are systematic differences in the global temp erature and carbon stocks year-to-year changes: temperature shows only minuscule change on an annual scale (as expected given its capacity to store relatively little energy); carbon show large changes.
- Complex relationships Inconsistent association with changes in temperature and carbon stock over years.

Limitations:

- We only analyzed year to year changes, without taking long term trends or other influencers into account.